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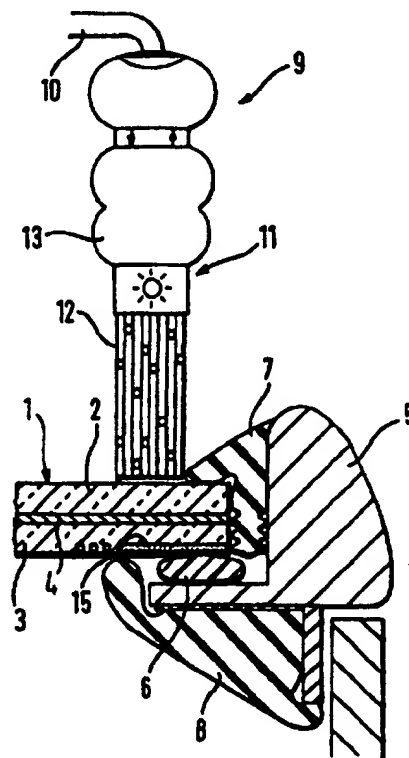
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(54) Title: RELEASING OF BONDED SCREENS

(57) Abstract

Bonded screens such as vehicle windscreens (1) bonded to a supporting frame (5) by homogeneous bonding material (6) are released by firstly arranging energy delivery means (9) adjacent the screen and subsequently transmitting energy from the delivery means through the screen thereby to effect release of the screen (1) from the frame (5) by either causing degradation of some of the homogeneous bonding material and/or cleavage or degradation of the screen material. The energy delivered may, for example, be ultrasonic or laser radiation, and is preferably arranged to be concentrated at a predetermined localised region to enhance the release mechanism.



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Releasing of Bonded Screens

The present invention relates to means for releasing a screen from a support structure or frame to which the screen is bonded. In particular the invention relates to means for releasing a glass pane or screen (such as a vehicle windscreen) bonded by means of an interposed bonding material to a frame.

Bonded vehicle windscreens commonly need replacing as a result of motoring accidents, vandalism etc. At present, the bonded connection between the windscreen and the support frame is typically released using manual, mechanical means such as the use of sharp angled blades, "cheese wire" techniques etc. Use of these known techniques sometimes causes damage to the vehicle (in particular the bodywork and interior trim) which can be expensive to repair. Furthermore, operatives using these known physical techniques are prone to injury as a result of accidents occurring whilst performing the task.

An alternative proposal for an adhesive joint enabling release of a bonded screen from a supporting frame is disclosed in CA-A-2073092 in which a heatable separating member is provided closely fitting or embedded in an adhesive bead. The heatable sealing member disclosed is heated to a temperature at which it is either destroyed or loses adhesion to closely fitting elements or parts of the joint. The disclosure emphasises that the separating element loses its adhesion or is destroyed at a temperature at which the adhesive bead is not damaged.

A problem with the proposal of CA-A-2073092 is that a relatively complex joint is required incorporating discrete heatable element and separate bonding bead which remains substantially unaffected when the heating element is heated. A further drawback is that at present the commercial market for replacement windscreens is substantially restricted to existing

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vehicles most of which have screens bonded to frames using a single homogeneous bead of polymeric bonding material interposed between the screen and frame. The bonding material is homogeneous to the extent that it is of substantially uniform composition throughout. In this context the homogeneous bonding material may sometimes comprise fillers or other particular additives materials substantially evenly distributed throughout the bonding material.

An improved means of releasing bonded screens has now been devised, which comprises a method of releasing a screen from a frame to which the screen is bonded by interposed homogeneous bonding material, the method comprising the steps of

- (a) arranging energy delivery means adjacent the screen; and
- (b) transmitting energy from said energy delivery means through material comprising the screen thereby to:
 - i) cause degradation of material comprising the homogeneous bonding material; and/or
 - ii) cleavage or degradation of material comprising the screen, thereby to effect release of the screen from the frame.

For performance of the invention in its broadest sense, it is necessary that the screen is transparent to the extent that the energy may be transmitted through the screen to permit release of the screen from the support frame.

The invention is, however, particularly suited for use in releasing (for replacement) vehicle windscreens which are commonly bonded in and to surrounding support frames. In this respect, the screen will typically comprise a material transparent to visible light (such as glass). The homogeneous bonding material preferably comprises a flexible polymeric material (preferably a rubber or elastomeric material such as polyurethane), typically provided as an homogeneous bead extending about the periphery of the screen, interposed between the screen and frame. Such homogeneous bonding material is used in modern vehicle windscreen fitting techniques, almost exclusively.

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It is preferred that the mechanism effecting release of the screen from the frame is pyrolytic degradation of the homogeneous bonding material, preferably of a portion of the body of the material most closely adjacent the screen. The degradation of the bonding material may alternatively be by photodissociation or photochemical degradation. Following degradation and release, a remainder portion of the homogeneous bonding material (substantially un-degraded) remains bonded to the frame. Where the bonding material comprises a synthetic organic polymeric material, the degradation when pyrolytic may comprise carbonisation of the material.

The energy delivery means is arranged adjacent a portion of the screen (typically a peripheral portion of the screen) which is bonded to the frame. The energy is then transmitted through the screen toward the location of the bonding material which is interposed between the respective portions of the screen and frame.

It is preferred that the energy delivery means is arranged to deliver wave energy to be transmitted through a localised region of the screen. The wave energy may be electromagnetic wave energy, such as light, or vibrational/sound energy.

In one embodiment, it is preferred that the energy delivery means comprises laser delivery means arranged to transmit laser radiation through the screen to release the screen from the frame. In this embodiment, it is preferred that the laser delivery means is arranged to transmit laser radiation having a wavelength in the visible/near infra-red region of the spectrum. Alternatively, the laser radiation delivered may be in the ultra-violet region of the spectrum.

The laser energy delivery means is preferably directed such that the radiation is transmitted to and absorbed by the bonding material, preferably in a specific portion (or notional layer) most closely adjacent the screen, as described above.

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The laser radiation may be focused at a predetermined location. Desirably the laser radiation is continuous wave and enables relatively high intensity/energy radiation to be delivered to, and effect degradation (pyrolytically or otherwise) of, specific localised regions of the bonding material, consequently minimising damage to portions of the screen and undegraded portions of the bonding material remaining.

Where the energy delivery means comprises ultrasonic delivery means, an ultrasonic transducer is preferably powered to generate ultrasonic energy of sufficient intensity to effect release of the screen. The ultrasonic energy is preferably arranged to be focused (or concentrated) at a predetermined location. The ultrasonic energy may effect release of the screen by pyrolytic degradation of the bonding material and/or cleavage of material comprising the screen. Alternatively, the ultrasonic energy may effect release by other means, such as for example by means of differential induced stresses at the bonding material/screen interface. It is believed that use of ultrasonic energy to effect release of a screen bonded to a frame may be novel and inventive per se.

Whether laser, ultrasonics, or other energy is used, it is preferred that the energy is arranged to be concentrated.

Desirably, the energy delivery means is arranged adjacent a first face of the screen, the screen being bonded to the support structure at a second, obverse, face.

It is preferred that tuning means is provided arranged to tune the frequency or intensity of the wave energy delivered by the energy delivery means.

Typically, the screen comprises glass and may comprise a glass/plastics laminated structure.

The invention is particularly suitable for the release for repair or replacement of vehicle windscreens; it is however suitable for use in other applications, such as for example release of architectural panels or glass screens (windows) bonded to architectural frames.

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The invention will now be further described in specific embodiments by way of example only, and with reference to the accompanying drawings, in which

Figure 1 is a schematic representation of a first exemplary method according to the invention; and

Figure 2 is a schematic representation of an alternative method according to the invention.

Referring initially to Figures 1 and 2, there is shown a vehicle laminated windscreen 1 comprising a pair of glass sheets 2,3 separated by an intermediate laminating plastics layer 4. Windscreen 1 is bonded to a vehicle windscreen frame 5 by means of an interposed homogeneous rubber bonding bead 6 which extends around the periphery of windscreen 1. Bonding bead 6 comprises a thermoplastic adhesive material applied as a viscous melt to the inner surface of windscreen 1 which is then fitted into frame 5, where bonding bead 6 hardens to securely bond the windscreen 1 to frame 5. The inner surface of windscreen 1 is provided with a peripheral ultra-violet (U.V) barrier comprising a screen-printed layer 15 arranged to inhibit U.V. radiation passing through the windscreen and impinging on the bonding bead 6, which could otherwise adversely affect the integrity of the bond. An external rubber seal 7 and internal vehicle trim 8 are provided at the screen 1/frame 5 connection for weatherproofing and cosmetic reasons respectively.

In order to remove the windscreen from the frame 5, laser delivery system 9 may be used as described below. The laser delivery system comprises a waveguide 10 directing laser radiation from an energy source (not shown) to an applicator head 11 which is placed adjacent the peripheral edge of the windscreen 1 to direct laser radiation through the windscreen 1. Applicator head 11 includes a beam guide 12 and a slidable on/off switch 13.

Continuous wave in laser radiation is directed from applicator head 11 through a localised portion of the windscreen 1 to impinge upon the bonding bead 6. The laser radiation, being

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in the visible and near infra-red region of the electromagnetic spectrum, is absorbed by the bonding bead 6 in the portion thereof immediately adjacent the underside of screen. Only that portion of the bead 6 immediately adjacent the screen 1 increases rapidly in temperature. The rapid temperature increase causes thermal pyrolytic degradation of the portion of the bead 6 immediately beneath screen 6, whilst leaving an underlying remainder layer/portion bonded to the frame.

Alternatively, the laser radiation may be concentrated or focused to heat that portion of the windscreen 1 immediately adjacent bonding bead 6 resulting in fragmentation/degradation or cleavage of the glass adjacent the screen printed layer 15 causing separation of the bonding bead 6 from the remainder of the windscreen.

Applicator head 11 is guided (either automatically or manually) around the entire periphery of the windscreen with the laser radiation activated to ensure complete separation around the entire periphery. The windscreen 1 may then be simply lifted from frame 5 and the surface of the remainder of homogeneous bead 6 pared, prepared and softened for a replacement windscreen to be fitted. Seal 7 may be removed prior to use of the laser delivery system.

A laser delivery system having the following parameters is suitable for performance of the invention.

Wavelength	820 nm
Donor	60 watts
Beam section	18mm by 4mm

The above parameters are given as an example only, and other laser delivery systems could be used providing the energy delivered is sufficient to cause the required degradation and/or fragmentation of the glass.

As an alternative to a laser delivery system, in accordance with the invention other energy delivery means may be utilised. Referring to Figur 3, there is shown apparatus for carrying out the invention utilising ultrasonic energy. An

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ultrasonic piezoceramics transducer 20 is placed in contact with the surface of sheet 2 of the windscreen 1, which has initially been prepared with a couplant gel (not shown) to maximise the proportion of energy transferred from the transducer 20 to the glass sheet 2 of windscreen 1. Ultrasonic acoustic energy is generated by transducer 20 which is connected to an electrical power supply 21. Ultrasound waves are transmitted through the windscreen 1 such that the rubber material of bonding bead 6 is removed either by cleavage of the material of glass sheet 3 immediately backing bead 6, pyrolytic degradation of the portion of bonding bead 6 contacting windscreen 1, or by separation due to ultrasonic vibration at the bead 6/windscreen 1 interface.

The separation or removal can be achieved by using ultrasound of sufficiently high intensity to induce high mechanical stresses within the glass, at the glass/rubber interface or in the bonding bead itself. Furthermore, the acoustic, ultrasonic energy may be focused to produce an enhanced effect, typically by use of a focusing element (not shown) and/or the provision of a suitable transition structure or layer on the contact surface of the transducer 20. Transducer 20 is guided around the entire periphery of the windscreen (either manually or more preferably automatically) to ensure complete release of the screen from the surrounding frame.

CLAIMS:

1. A method of releasing a screen from a frame to which the screen is bonded by interposed homogeneous bonding material, the method comprising the steps of
 - (a) arranging energy delivery means adjacent the screen; and
 - (b) transmitting energy from said energy delivery means through material comprising the screen thereby to:
 - i) cause degradation of material comprising the homogeneous bonding material, and/or
 - ii) cleavage or degradation of material comprising the screen, thereby to effect release of the screen from the frame.
2. A method according to claim 1, wherein a portion only of the bonding material is degraded, a remainder portion of said homogeneous bonding material remaining un-degraded and bonded to the screen or in the frame.
3. A method according to claim 2, wherein the remainder portion of the bonding material remains bonded to the frame.
4. A method according to any preceding claim, wherein the bonding material is provided as a bead extending around the periphery of the screen, the energy delivery means being arranged adjacent a peripheral portion of the screen to effect localised release of a portion of the screen, and tracked to follow the bead around the periphery of the screen thereby to effect complete release of the screen.
5. A method according to any preceding claim, wherein the wave energy delivered is electromagnetic energy of a wavelength and intensity suitable for;

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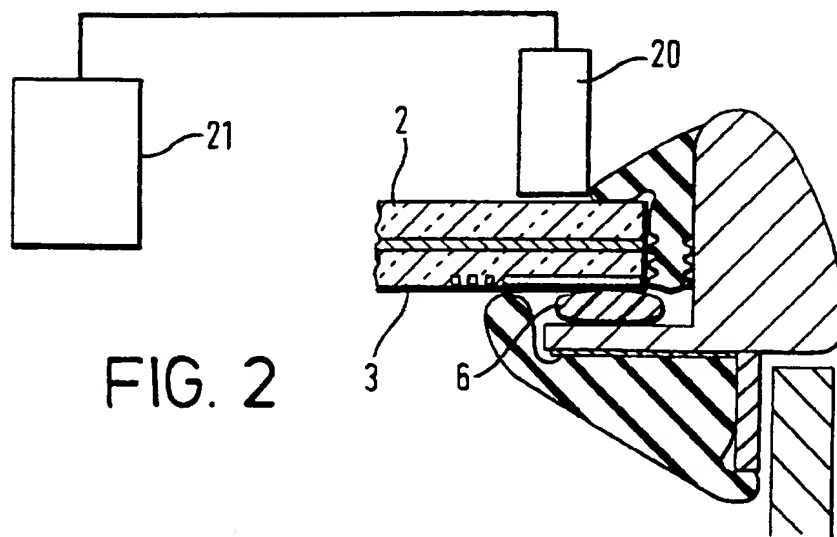
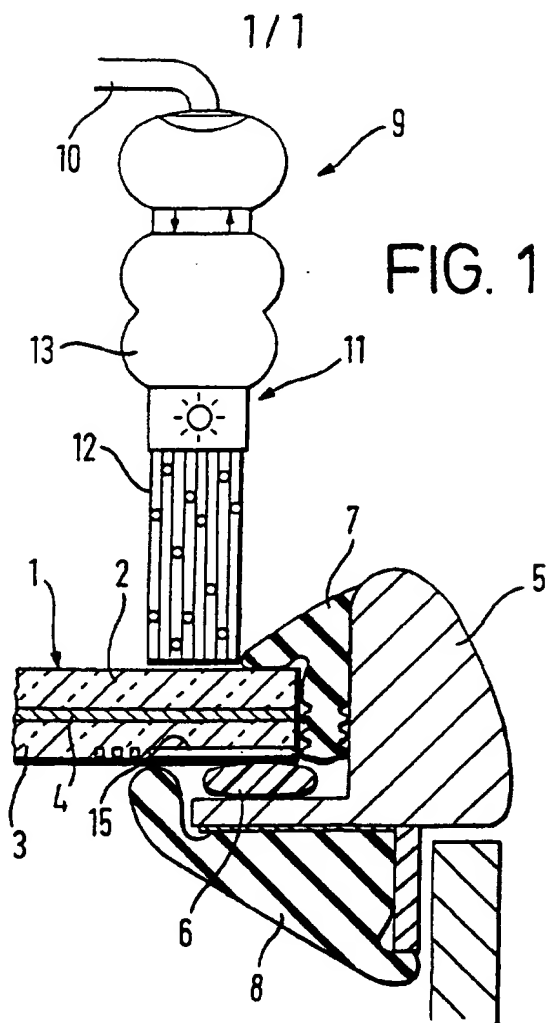
- a) transmission through the screen; and
 - b) absorption by the homogeneous bonding material to a degree sufficient to cause degradation thereof, and/or cleavage or degradation of material comprising the screen.
6. A method according to any preceding claim, wherein the energy delivered is arranged to be concentrated at a predetermined location.
 7. A method according to any preceding claim, wherein the energy delivery means comprises laser delivery means arranged to transmit laser radiation through the screen to release the screen from the frame.
 8. A method according to claim 8, wherein the laser radiation is pulsed.
 9. A method according to claim 8, wherein the laser radiation is continuous wave.
 10. A method according to any of claims 7 to 9, wherein the laser delivery means is arranged to transmit laser radiation having a wavelength in the ultra-violet, visible or near infra-red region of the spectrum.
 11. A method according to any of claims 7 to 10, wherein the laser delivery means is arranged to transmit laser radiation having a wavelength substantially in the range 1000 nm or less.
 12. A method according to any of claims 7 to 11, wherein the laser energy delivery means is directed such that the radiation is transmitted to and absorbed at an absorbing layer comprising the screen, the absorbing layer being contiguous with the bonding material bonding the screen to the frame.

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13. A method according to any of claims 8 to 12, wherein the laser radiation is focused at a predetermined location.
14. A method according to any of claims 1 to 5, wherein the energy delivery means comprises ultrasonic delivery means arranged to transmit ultrasonic energy through the screen to effect release of the screen from the frame.
15. A method according to claim 14, wherein the ultrasonic energy is arranged to be focused (or concentrated) at a predetermined location spaced from, or at, a surface of the screen.
16. A method according to any preceding claim wherein the energy delivered is tunable such that the frequency or intensity of the wave energy delivered may be varied.
17. A method of replacing a screen in a frame, the method comprising releasing a frame from the screen in accordance with the method of any preceding claim and subsequently replacing the same screen, or a different screen, in the frame and securing the screen in the frame.
18. Apparatus for use in performing the method of any preceding claim, the apparatus comprising energy delivery means arrangeable adjacent the screen and actuatable to deliver energy through a localised portion of the screen in order to effect release of the screen from the frame.
19. Apparatus according to claim 18 which is arranged to be moved about the periphery of the screen to effect complete release of the screen.

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20. A method of releasing a screen from a frame to which the screen is peripherally bonded by interposed bonding material, the method comprising the steps of:
- (a) arranging laser energy delivery means adjacent the screen;
 - (b) transmitting laser energy from said laser energy delivery means through material comprising the screen thereby to effect localised release of the screen from the frame in the region of transmission of the laser energy; and
 - (c) tracking the laser energy delivery means about the periphery of the screen thereby to effect complete release of the screen from the frame.



INTERNATIONAL SEARCH REPORT

Internat. Application No
PCT/GB 95/02847

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B60J1/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B29C B60J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP,A,0 492 786 (FORD MOTOR COMP.) 1 July 1992 see column 8, line 43 - column 9, line 27; figure 4 see column 9, line 27 - line 31 see column 9, line 40 - line 43 see column 9, line 46 - line 51 see column 4, line 54 - line 58 ---	1,4-6, 16-18
X	US,A,5 269 868 (E. GOFUKU ET AL.) 14 December 1993 see column 5, line 32 - line 45 --- -/-	1,4-8, 10,11, 13,17-20

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
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A	EP,A,0 319 023 (ASHLAND OIL INC.) 7 June 1989 see column 4, line 29 - column 5, line 14; figures 2,3 see column 5, line 39 - column 6, line 8; figure 3 ---	1,4-6, 17,18
A	FR,A,2 508 267 (SAINT-GOBAIN VITRAGE) 24 December 1982 see the whole document ---	1,18
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